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Cornell scientists unravel the sexual chemistry of the German cockroach

By Linda McCandless

GENEVA, N.Y. — The sexual chemistry of the German cockroach has baffled scientists for years. Meanwhile the insect, which is one of the most serious food and residential pests worldwide, has been busily fouling up the planet essentially unhindered. *Blattella germanica* plagues humans in homes, apartments, restaurants, supermarkets, hospitals and any buildings where food is stored, prepared or served. The cockroach is notoriously resilient and difficult to control.

But homeland security for the pesky cockroach has just become a thing of the past. A team of entomologists working at Cornell University's College of Agriculture and Life Sciences, the State University of New York College of Environmental Science and Forestry, and North Carolina State University have succeeded in isolating, characterizing and synthesizing the sex pheromone of the female German cockroach, thus providing an important new tool for the control and management of the pest. The study is reported in *Science* this week.

"We expect this pheromone to provide the basis for powerful new tools to eliminate populations of this insidious pest," said Wendell L. Roelofs, the Liberty Hyde Bailey Professor of Insect Biochemistry at Cornell University. The pheromone, gentisyl quinone isovalerate, or "blattellaquinone," as the scientists call it, has proven to be a highly effective lure in field trapping tests.

"Understanding this new chemical structure should prove invaluable in monitoring and control," said Roelofs.

Pictures are linked to hi-res scans

Press Release Photo

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Wendell Roelofs teases a male cockroach with synthetic sex pheromone. Inset - close up photo of male cockroach.
Photo Credit: NYSAES

The team was able to achieve a breakthrough in determining the chemical's molecular structure by locating the pheromone-producing cells in the female, isolating minute amounts of a fairly unstable compound, and then devising an ingenious gas chromatograph collection technique for obtaining pure samples for nuclear magnetic resonance analysis.

The work was conducted by Roelofs and postdoctoral associate Satoshi Nojima at Cornell's New York State Agricultural Experiment Station in Geneva, New York in collaboration with Coby Schal, the Blanton J. Whitmire Professor of Entomology at North Carolina State, his technician, Richard Santangelo, and Francis X. Webster of the department of chemistry at the College of Environmental Science and Forestry.

Volatile "come-hither" chemicals called pheromones are used by insects to attract the opposite sex. The chemicals are carried over great distances in "pheromone plumes" and, in the case of the German cockroach, picked up by extremely sensitive olfactory response systems in males. The males follow the females' pheromone plume to the odor source. Mating ensues, and the population grows.

Roelofs is often called the "father of pheromone chemistry." His identification and synthesis of a series of sex pheromones from species such as the Oriental fruit moth, the codling moth, the tomato pinworm, the peach twig borer, and the European corn borer, together with the then-novel approach of using electroantennogram bioassays, led to the development of pheromone mating disruption as an alternative to pesticides.

The work is painstaking. The electroantennogram uses the insect antenna as a biological odor detector; when coupled to a gas chromatograph, it can reveal active components in messy mixtures. Flight tunnels are used to measure the male behavioral responses and then tests are conducted in the field. The synthetic compounds are then commercialized into bio-based products that can be used in homes, agriculture, turf and landscape settings. For his work in pheromone chemistry, Roelofs won the prestigious Wolf Foundation Prize for Agriculture in 1982 and was elected to the National Academy of Sciences.

"Several companies are interested in using the blattellaquinone pheromone in monitoring traps, since there is a great need to find some way of luring these cockroaches into traps and insecticide baits," said Roelofs. He expects the technology to be commercialized and agreements to be made with the Cornell Patent Office.

In addition to fouling food, German cockroaches carry certain bacterial diseases that can result in food poisoning, dysentery or diarrhea. They damage wallpaper and books, eat glue from furniture, produce unpleasant odors and are frequently the cause of childhood asthma.

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Related Links: Wendel Roelofs' Faculty Web Page

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